[0032] In another aspect of the present invention, the described system can be dispatched by so-called smart-grid management control (Systems Operators) so as to provide a net-export of peaking power to an overstressed local neighborhood micro-grid or a larger transmission and distribution system. A plurality of such systems strategically deployed in a geographical grid would provide crucial load shedding capability during a power emergency or high temperature day where Utility systems are caught in a net under-capacity situation. In this case, it is likely that the fossil fueled generator could also be used to provide external power and be economical in its use. For instance, in the long hot spells of summer, the cost per kilowatt-hour for peaking or imported power is often more expensive than the estimated 21 cent to 35 cent per kilowatt hour fuel costs for running an auxiliary, fossil fueled generator. The integration of renewable energy sources to these home-systems simply improves the economic benefit of their deployment in that they could easily be operated when time-of-day prices for power exceed the total operating costs of the collection of distributed, individually owned integrated power systems described in this application.

[0033] In another aspect of this invention the waste heat from the operation of the IC Generator may be captured and used for thermal energy control at the load (heating or cooling for example). Such combined heat and power (CHP) systems are well described in the literature. In common practice CHP systems demonstrate a thermal-equivalent efficiency of more than twice the rated electric power alone (as may be generated by the I/C. engine) and may represent an ideal economic or environmental application of this invention. For example where solar-thermal renewable energy systems are employed the described energy management system can become a central-hub for generating and controlling both electric and thermal energy on site. For example on a cold winter night the system could recharge batteries and heat the residence to optimize the fossil fuel efficiency of the system.

[0034] In one aspect of the present invention a conventional back-up generator system is enhanced so as to provide an integrative function of adding to its output the power available in renewable energy or stored energy systems which are typically external to the generator housing. These external electrical sources may for example be a solar photovoltaic system, a fuel cell, small wind turbine, and/or a battery storage system. Since these energy sources are typically direct current, a "package inverter and control device" (**118**) can be mounted with the generator cabinet and used to feed A.C. to the distribution panel (**116**) in parallel with the generator's power output (FIG. **1**).

[0035] FIG. **1** depicts a conventional generator-set fueled by liquid, fossil, gaseous, or bio-fuels, using an internal combustion engine (**110**) to drive a synchronous-frequency controlled AC generator (**112**) which has the ability to add diverse energy (renewable and stored energy) resources **118** using a software defined control algorithms and power switching elements (**114**). In many cases these alternative energy sources (**118**) will be direct current sources and will need to be converted to synchronous alternating current when paralleled with the generator's rectified output to supply the external load (**116**). Thus this embodiment requires a separate DC to AC inverter (**118**) to provide combined power to the systems output distribution panel. In this configuration the power sources are paralleled and combined on the system's inverter side of the automatic transfer switch which provides the required anti-islanding protection to meet common Utility interconnect requirements such as UL 1741 and IEEE 1547 permitting the integrated system to provide power to the load in the event of a grid power outage by the grid-isolating function of the transfer switch. This provision reduces the cost of the inverter by eliminating the anti-islanding circuitry and allows the inverter to operate in so-called off-grid mode continuously through the use of the standard transfer switch commonly provided with standby generator systems.

[0036] In another aspect of the present invention a permanent magnet alternator or actively rectified wound-field generator (**212**) is directly driven by the internal combustion engine (**210**) (FIG. **2**). The variable speed, variable frequency, typically three phase electric output of the alternator is rectified and used to feed the power switching transistors in a inverter (**214**) to create fixed-frequency (50 HZ or 60 HZ for example) alternating current having the power quality to be allowed in grid-parallel operation. This power inverter section may be sized to be equal to the maximum power output of the internal combustion engine or oversized to allow renewable energy or stored energy to be additively combined with the systems total output.

[0037] FIG. **2** depicts an I.C. motor-generator, heavy or light fueled (**210**), which drives a multi-phase, variable speed, variable frequency permanent magnet alternator or an actively rectified generator (**212**). The output of the alternator is fed into a multi-phase, bridge-rectified, power transistorized switching inverter (**214**) which is optimally transformer less for lighter weight and less cost. The inverter may be power-matched to equal the maximum rated power of the IC motor or oversized to allow the full power ratings of the system to significantly exceed the power rating of the fossil generator alone. This configuration has the advantage of eliminating the separate inverter used in FIG. **1** above. If this inverter is generously oversized its power handling capability can meet the maximum rated load specified by the power-system's full load rating by drawing from proximal renewable energy sources or stored energy devices (**220**). In actual practice, the I.C. motor-generator may be reduced in size in proportion to the power rating of the added alternative/renewable energy technologies to be deployed. The output of this master-inverter feeds the included transfer-switch and smart-distribution panel (**216**). This configuration will allow the alternative energy system (a solar panel installation for example) to be used on a daily basis to offset the need for utility supplied power without the need to run the I.C. motor generator. When the grid signal is missing the transfer switch disconnects the overall system from the grid and isolates the load (**218**) to the back-up power system with all of its enhanced renewable energy and energy storage capabilities.

[0038] In a preferred embodiment of this invention, the internal combustion engine (**310**) will directly drive a permanent magnet alternator or a wound-field, actively rectified generator (**312**) which will create a three-phase, varying frequency, alternating current electric power feed (**314**) to a bridge-rectifier (**316**) which in turn creates a rectified, non-filtered direct current link (**318**) to the software controlled power integration center (**322**), including engine control **322***a* (FIG. **3**). The actively rectified generator's output would be a phase controlled and rectified output as opposed to a multi-phase alternating current of the PM-alternator.